201-14874

BPD/BPA Coalition

BPD/BPA Coalition
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November 29, 2003

The Honorable Mike Leavitt, Administrator
U.S. Environmental Protection Agency
P.O. Box 1473
Merrifield, VA 22116

Re: BPD/BPA Coalition Submission of HPV Test Plan and Robust Summaries under the Chemical Right-to-Know Program for Benzene Phosphorous Dichloride (CAS No. 644-97-3) and Phenylphosphinic Acid (CAS No. 1779-48-2).

Dear Administrator Leavitt:

The BPD/BPA Coalition submits the attached test plan for Benzene Phosphorous Dichloride (BPD - CAS No. 644-97-3) and Phenylphosphinic Acid (BPA – CAS No. 1779-48-2) under the High Production Volume Chemicals Challenge Program. Robust summaries for the HPV chemicals BPD and BPA are also included. In addition, robust summaries are included for PPOA (phosphonic acid, phenyl-) (CAS# 1571-33-1) which, although not an HPV chemical, is, under non-manufacturing conditions, a major hydrolysis product of BPD. As documented in the test plan, BPA serves as the appropriate surrogate for BPD and its hydrolysis products, including PPOA for the purposes of the program. The test plan also includes a detailed discussion of the hydrolysis of BPD under manufacturing and non-manufacturing conditions.

The BPD/BPA Coalition is currently comprised of Ferro Corporation and Akzo-Nobel Functional Chemicals LLC. Avecia was a member of the coalition, but has recently disposed of its BPD-related product line.

Please direct any comments to the BPD/BPA Coalition Executive Director, William Smock at William.smock@verizon.net.

William H. Smock
Executive Director

BPD/BPA Coalition

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BPD (Benzene Phosphorous Dichloride) and BPA (Benzene Phosphinic Acid)

HPV TEST PLAN

Submitted to the U.S. Environmental Protection Agency

by the

BPD/BPA Coalition

November, 2003

1. Introduction

Although nominally reaching the production trigger for the HPV program, the materials in this test plan Benzene Phosphorus Dichloride (BPD) and its hydrolysis product, Benzene Phosphinic Acid (BPA) are cases where a high production volume does not correlate with a high exposure potential.

1.1. Manufacturers

In July, 2003, the three known manufacturers of phenyl phosphonous dichloride (BPD – CAS # 644-97-3) or phenyl phosphinic acid (BPA – CAS # 1779-48-2) (Avecia, Inc.; Ferro Corporation; and Akzo-Nobel Functional Chemicals LLC) were surveyed about customers, distribution, use, and TCSA 8(c) records for these products by the BPD/BPA Coalition Executive Director who summarized the member's confidential responses.[1] These summary survey results are the basis for the information in items 1.2 through 1.5.

1.2. Customers

Two of the manufacturers produce BPD, all three handle BPD and two produce BPA. The number of BPD/BPA customers is less than 10, with usage at a very limited number of sites.

1.3. Distribution

The manufacturers of BPD and BPA sell directly to customers except for laboratory chemical distributors. The quantity of either material distributed to chemical distributors is very small (fewer than 3 distributors) and generally in small quantities (20 – 30 pounds per sale) with total annual sales to laboratory distributors are less than $1,000. Almost all of BPD sales are to major customers who use the material as an intermediate to convert into BPA as a photoinitiator and reactive polymer additive. In the few cases where a manufacturer sells to an agent, the end customer is known to the manufacturer. All three manufacturers have the understanding that BPA customers react/consume the material at the time of usage.

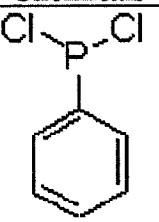
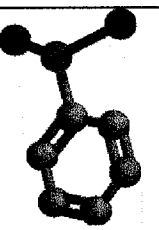
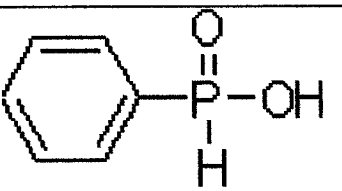
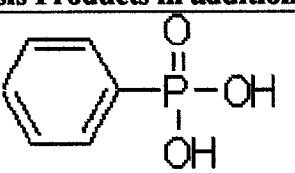
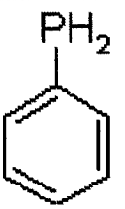
1.4. Uses

Almost all of the BPD is converted to BPA. BPA is used primarily in nylon applications. A small amount of BPD is consumed at customer sites for applications in flame retardants which are reacted into polymers. Some BPD is used for research purposes in very small quantities. Less than 1000 pounds per year of BPD is used in pharmaceutical manufacturing. Even smaller quantities of BPD are used as an intermediate in other processes.

1.5. TSCA 8 (c) Reports

None of the manufacturers of BPD and/or BPA had any allegations of significant adverse reactions (TSCA 8(c) reports) on file. The production of BPD and BPA began in the early 1960's.

2. Chemical Names, Formulas, and Structures

CAS# (CAS Name) [Common Name] Acronym	Formula[2]	2-d Structure[3]	3-d Model[4]
HPV Chemicals			
644-97-3 (Phosphonous dichloride, phenyl-) [Benzene phosphorus dichloride] **(BPD)**	$C_6H_5Cl_2P$		
1779-48-2 (Phosphinic acid, phenyl-) [Benzene phosphinic acid] **(BPA)**	$C_6H_7O_2P$		
BPD Hydrolysis Products in addition to BPA			
1571-33-1 (Phosphonic acid, phenyl-) [Phenyl phosphonic acid] **(PPOA)**	$C_6H_7O_3P$		
638-21-1 [Phenyl phosphine] **(PP)**	C_6H_7P		

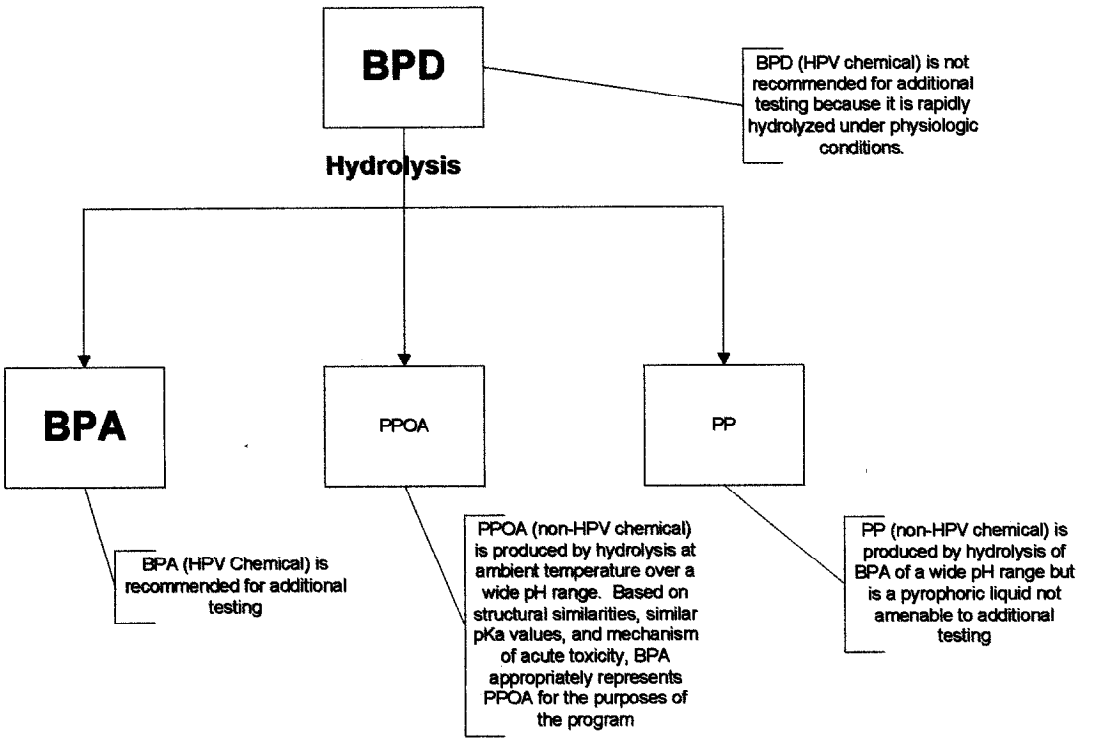
Note: The form shown is the most prevalent tautomeric form of the free acid.[5]

3. BPD/BPA Test Plan Summary

Although reaching the production trigger for the HPV program, the materials in this test plan Benzene Phosphorus Dichloride (BPD) and its hydrolysis product, Benzene

Phosphinic Acid (BPA) are a case where a high production volume does not correlate with a high exposure potential.

Relationship of Chemicals Discussed in Test Plan



BPD and BPA are both recommended for determination of selected physiochemical properties and BPA is recommended for the genetic toxicology testing needed to fill data gaps.

Under industrial conditions with control of temperature, addition rate, and pH, BPD is typically hydrolyzed to BPA with yields greater than 99.9%.

Under the test conditions of the OECD 111 guidelines, BPD is very rapidly hydrolyzed to BPA, PPOA and the pyrophoric liquid phenylphosphine.

Because BPA adequately represents PPOA for toxicity testing due to their chemical, structural, and toxicologic similarities and because phenylphosphine is impractical to test, BPA is the material most appropriate for ecotoxicology testing. BPA was considered for mammalian toxicology testing but was rejected based on the considerations described below.

Three main considerations (animal welfare, absorption, and existing data) lead to the conclusion that BPA should not be recommended for any mammalian toxicology testing by any route of administration. The considerations leading to this conclusion are: (1)

existing animal data that shows that BPA by oral gavage causes gastrointestional tract bleeding, necrosis, and occasionally perforation, (2) the reported pKa values for BPA and PPOA are less than 2 and therefore BPA is mainly in the ionized form upon ingestion and absorption in the stomach will be low and even lower in the intestines, and (3) the existing acute and subacute study data are consistent with the view that the corrosive effects of BPA are the basis for its toxicity. Even dilute solutions of BPA would not be appropriate for mammalian testing, especially in a repeated-dose study design. It is not appropriate to test even dilute solutions of BPA in animals because: (1) no NOEL has been reported for gastrointestinal hemorrhage induced by BPA, (2) it is likely that even dilute solutions would cause gastrointestinal irritation and its consequent distress, (3) dilute solutions are not relevant to the industrial use of BPA , and (4) the primary toxicity of BPA is explained by its acidic properties, thus testing dilute solutions would not be relevant to the materials as used in industrial applications and would ignore their primary mechanism of toxicity.

4. Table of Available and Sufficient Data for BPD and BPA and Proposed Testing

Endpoint	BPD		BPA	
	Data Available & Sufficient	Testing Proposed	Data Available & Sufficient	Testing Proposed
Physical/Chemical Characteristics				
Melting Point	Yes	No	No	Yes
Boiling Point	Yes	No	No	Yes
Vapor Pressure	No	Yes	No	Yes
Partition Coefficient	No	No (decomposes)	No	Yes
Water Solubility	No	No (decomposes)	No	Yes
Environmental Fate				
Photodegradation	No	Calculate***	No	Calculate***
Stability in Water	No	Ongoing	No	Ongoing
Biodegradation	No	Calculate***	No	Yes
Transport (Fugacity)	No	Calculate***	No	Calculate***
Ecotoxicity				
Acute Toxicity to Fish	No	No*	No	Yes
Acute Toxicity to Invertebrates	No	No*	No	Yes
Acute Toxicity to Aquatic Plants	No	No*	No	Yes
Mammalian Toxicity				
Acute Toxicity	Yes	No	No (BPA) Yes (PPOA)	No**
Repeated Dose Toxicity	No	No*	No	No**
Reproductive Toxicity	No	No*	No	No**
Developmental Toxicity	No	No*	No	No**
Genetic Toxicity				
Bacterial Gene Mutations	Yes	No	No (BPA) Yes (PPOA)	Yes
Chromosomal Aberrations (in vitro)	No	No****	No	Yes

* No testing proposed as BPD rapidly hydrolyzes to BPA and related compounds

** No testing proposed based on animal welfare concern that repeated dosing is likely to cause serious animal distress

*** Calculated data to be updated after obtaining adequate values for physiochemical properties

**** BPD will be tested if there is an important difference in the profile of BPD and BPA in the bacterial mutagenesis assay

5. Category Justification

The basis for treating the high production volume (HPV) chemicals BPD and BPA as members of a category for the purposes of the HPV program is that, across a wide pH range, BPD rapidly hydrolizes converting primarily to BPA and the structurally similar PPOA (which is not an HPV chemical) with the remainder converting to phenylphosphine (a pyrophoric liquid which is impractical to test).

Based on draft data from an OECD 111 guideline study, BPD hydrolizes to BPA, PPOA, and phenylphosphine in about 1.5 minutes at the pH values tested ranging from 1.2 to 9[6] in an exothermic reaction producing HCl. The OECD 111 guideline conditions do not represent commercial production. In commercial production, the hydrolysis of BPD to BPA is controlled to give a yield of 99.9% or greater.

Because it is practical to make stock aqueous solutions of BPA up to about 7% concentration for use in testing, BPA will be used as the test material for the ecotoxicology and genetic toxicology studies recommended in this test plan. Depending upon the relative profiles of BPD and BPA in the bacterial mutagenesis assay, BPD may be tested in an in-vitro chromosomal aberrations assay

5.1. Preliminary BPD hydrolysis data

The following BPD hydrolysis information is from the draft report of an OECD 111 guideline study being performed by Wildlife International, Easton, MD.[6]

The hydrolysis of BPD was monitored by recording the voltage output of a Cl^- electrode on a strip chart recorder. Completion of the hydrolysis under the test conditions was determined by an asymptotic voltage output from the Cl^- electrode which was reached in less than two minutes under all test conditions. Aliquots were taken for HPLC analysis at approximately 5 minutes following the addition of BPD in acetonitrile to the appropriate buffer.

pH	Mass Balance for the Percentage of Nominal Mass of BPD in pH-Adjusted Reagent Water			
	Cl^-	PPOA	BPA	PP
1.2	39.6	35.8	20.5	12.4
4	39.6	29.3	25.5	5.59
7	39.6	32.1	22.1	6.44
9	39.6	29.5	27.4	5.81

Although the proportions of the hydrolysis products vary with pH, PPOA and BPA are the predominant hydrolysis products.

5.2. BPA as Representative of the Hydrolysis Products

PPOA and BPA are structurally similar, they have similar pKa values which are less than 2, and they have similar acute toxicities, therefore BPA, the HPV material, is the practical and appropriate test material to represent the BPD/BPA category and the hydrolysis products of BPD.

BPA and PPOA are more structurally similar than is often appreciated. Although PPOA is traditionally shown with a P=O bond, this does not imply π-bonding. The P=O bond may be thought of as a coordinate bond with primarily σ-character.[7] Similarly, although BPA is typically shown with two –OH groups, this structure represents the less prevalent tautomeric form. The more prevalent of free BPA form has a P=O bond[5] as does PPOA.

Use of BPA to represent the BPD/BPA category is supported by the data that, although not directly comparable because of the difference in experimental designs (fixed-doses versus acute toxic class), shows that the existing lethality data for acute oral gavage dosing of BPD, BPA, and PPOA are similar. The other product of the hydrolysis of BPD, phenylphosphine, is not amenable to testing because it is a pyrophoric liquid.

BPA is the appropriate material to use for the testing recommended in this test plan because: (1) of the rapid hydrolysis of BPD primarily to BPA and PPOA, (2) BPA is the HPV chemical in this program, and (3) PPOA is not an HPV chemical.

6. Test Plan Considerations

6.1. BPA Mechanism of Toxicity:

The acute toxicity of BPA is similar to that of mineral acids, for example sulfuric acid[8] and appears to be the manifestation of gastrointestinal hemorrhage and sequalae. This is not surprising given that BPA is a relatively strong organic acid with literature reported pKa values of 1.35 and 1.92[9] in aqueous media. Because the reported pKa values are less than both the typical pH of the stomach (pH =2) and intestine (pH=6), neither area would favor absorption of the nonionized form[10]

6.2. PPOA Mechanism of Toxicity

The acute toxicity of PPOA is similar to that of BPA with a similar LD50 (2000 mg/kg) [11] or between 500 and 2000 mg/kg in another study[12] and necropsy findings similar to those of BPA with gastrointestinal hemorrhage in the fatalities[11] and descriptions of multiple brown indistinct areas or multiple black eroded areas in the glandular mucosa of the stomach[12].

The reported pKa value for PPOA is 1.85[13] which is similar to that reported for BPA. Because the pKa value is less than both the typical pH of the stomach (pH =2) and intestine (pH=6), neither area would favor absorption of the nonionized form[10].

6.3. BPD Mechanism of Toxicity

The acute toxicity of BPD appears similar to that of BPA and PPOA. Because the single animal tested in the rangefinding study at 2000 mg/kg died and 5 animals dosed in the main study at 500 mg/kg survived[14], the acute toxicity is comparable to that of BPA and PPOA despite the differences in experimental design. The female animal dosed with 2000 mg/kg was found dead on the day after dosing. The necropsy notation was, "Stomach and intestine contents dark (black)", which is consistent with death by gastrointestinal hemorrhage.

6.4. Consideration of Human Experience

In a BPD/BPA Coalition survey of the manufacturers of BPD and BPA[1], there were no TSCA 8(c) allegations of adverse effect reports on file. There is no indication that there are unknown hazards associated with BPD and BPA.

6.5. Consideration of Animal Welfare

The acute oral toxicity of BPA appears to be secondary to causing gastrointestinal bleeding and consequent animal distress.

No additional mammalian toxicology testing by the oral route is recommended because of the likelihood of gastrointestinal bleeding and animal distress even with dilute solutions which would be exacerbated with repeated dosing.

Similarly, no additional mammalian toxicology testing is recommended by the dermal route because the most relevant study, a combined repeated dose/reproductive study with the OECD 422 design by the most relevant route (dermal) would be expected to cause severe skin irritation with repeated dosing and produce serious animal distress which would interfere with the purpose of the study.

7. Evaluation of Existing Data and Proposed Testing

7.1. Physical/Chemical Properties

Few of the physical/chemical properties data are available from reliable sources and testing will be required to meet the objectives of the program.

HPV Chemicals

CAS # Chemical	MW	MP °C	BP °C	Vapor pressure (mmHg)	Water Solubility (mg/L)	Log Kow	Physical Appearance.
644-97-3 BPD	178.98[15]	-51[16]	225[17]	10 @98°C[18]	Decomposes	Decomposes	Colorless liquid
1779-48-2 BPA	142.1[20]	83[19]	180[20]	0.00014[21]	77,000 @25° C[22]	0.04[23]	White crystalline solid[24]

BPD Hydrolysis Products in addition to BPA

CAS # Chemical	MW	MP °C	BP °C	Vapor pressure (mmHg)	Water Solubility (mg/L)	Log Kow	Physical Appearance
1571-33-1 PPOA	158.1[25]	162[26]	Decomposes @ 271 C[27]	0.2 mmHg @ 25 C[28]	278,000[29]	0.52[30]	White crystalline solid[31]
638-21-1 Phenyl-phosphine	110.1[32]	No Data	160.5[33]	2.51[34]	<1000[35]	1.49[36]	Colorless liquid PYROPHORIC[37]

Except where the properties of the material preclude meaningful testing, i.e. decomposition of BPD in water, BPD and BPA physical chemical properties other than physical appearance and handbook values will be determined by current OECD guideline methods.

7.2. Environmental Fate and Ecotoxicology

There is little existing experimental data on the environmental fate and ecotoxicity of the BPD, BPA or PPOA. The values in the tables are model calculations and testing will be required to meet the objectives of the program

HPV Chemicals

CAS # Chemical (Mol. Weight)	Environmental Fate				Ecotoxicity LC50 or EC50 (mg/L)		
	Photo-degradation (hr.).	Stability in water (25°C)	Bio-degradation	Transport/ Distribution	Fish (96 hr)	Aquatic Invertebrates (48 hr)	Aquatic Plants
644-97-3 **BPD** (179)	No Data	Decomposes to BPA, PPOA, phenylphosphine, and ,HCl,	See BPA	See BPA	See BPA	See BPA	See BPA
1779-48-2 **BPA** (142)	No Data	No data	Fast[38]	Primarily distributes to Water and Soil[39]	7328[40]	6857[41]	3830[42]

BPD Hydrolysis Products in addition to BPA

CAS # Chemical (Mol. Weight)	Environmental Fate				Ecotoxicity LC50/EC50 (mg/L)		
	Photo-degradation (hr.).	Stability in water (25°C)	Bio-degradation	Transport/ Distribution	Fish (96 hr)	Aquatic Invertebrates (48 hr))	Aquatic Plants
1571-33-1 **PPOA** (158.1)	57.6[43]	No data	Fast[44]	Primarily distributes to Water and Soil[45]	28848[46]	27907[47]	16022[48]
638-21-1 **Phenylphosphine** (110.1)	65.8[49]	No data	Fast[50]	Primarily distributes to Water and Soil[51]	246[52]	255[53]	154[54]

Photodegradation and Transport/Distribution will be recalculated following determination of physical/chemical properties. Biodegradation, and ecotoxicity to fish, aquatic invertebrates, and aquatic plants will be evaluated for BPA using OECD guideline methods.

7.3. *Acute Toxicity*

Some useful acute toxicity information is available for the HPV chemicals and BPD hydrolysis products. Because of the considerations described in detail below, only genetic toxicity endpoints are recommended for additional testing.

HPV Chemicals

CAS# Chemical (Mol. Weight)	Acute LD_{50}	Repeated dose	Reproductive	Develop-mental.	Genetic toxicty	
					Mutagenicity	Chromosomal Aberrations.
644-97-3 **BPD** (179)	>500 mg/kg[55]	No Data	No Data	No Data	Mutagenic	No Data
1779-48-2 **BPA** (142)	1710 mg/kg (oral gavage) >4640 mg/kg (dermal)[56]	NOAEL – 863 mg/kg/day for 10 days in rat diet	No Data	No Data	No Data	No Data

BPD Hydrolysis Products in addition to BPA

CAS # Chemical (Mol. Weight)	Acute LD_{50}	Repeated dose	Reproductive	Develop-mental	Genetic toxicty	
					Mutagenicity	Chromosomal Aberrations.
1571-33-1 **PPOA** (158.1)	2000 mg/kg[57] 500-2000 mg/kg[12]	No Data	No Data	No Data	Not Mutagenic[58]	No Data
638-21-1 **Phenylphosphine** (110.1)	LC_{50} 38 ppm/4 hours[59]	LOAEL 7.6 ppm in rats exposed for 10 days[60] LOAEL 2.2 ppm in dogs exposed for 90 days	Irreversible testicular degeneration in rats exposed to 2.2 ppm for 90 days. Reversible testicular degeneration in dogs exposed to 2.2 ppm for 90 days[61]	No Data	No Data	No Data

7.3.1. Oral

The toxicity profile of BPA shares the characteristic of tissue destruction with mineral acids such a sulfuric or hydrochloric acids. In an acute study[62] where BPA was administered to male rats by gavage and the calculated LD50 was 1710 mg/kg, the survivors at 1000 mg/kg had areas of necrotic tissue in their gastrointestinal tracts and the rats that died at 2150 mg/kg had extensive areas of gastrointestinal hemorrhage. At 2150 mg/kg death occurred in 10-14 hours, while with 4640 mg/kg, death occurred in 2-5 hours. The clinical signs noted at 1000 mg/kg of depression subsiding at 48-96 hours are consistent with acidosis and shock following gastrointestinal hemorrhage. Similarly, the

clinical signs noted at higher levels or depression with periods of excitation and soft dark stool are consistent with serious gastrointestinal bleeding and consequent distress.

An approximate lethal dose (ALD) for BPA was 2250 mg/kg in a study where rats dosed with BPA where lethal doses produced acute gastric distress, distended abdomen, and signs of shock. At necropsy there was evidence of gastric necrosis and spillage of the gastric contents into the abdominal cavity. Four animals that received less than the ALD (as low as 450 mg/kg) showed evidence of gastritis[63].

The structurally similar material, PPOA had a similar acute toxicity profile in Sprague Dawley male rats with an LD50 of 2000 mg/kg, clinical observations of depression, gastrointestinal hemorrhage in fatalities, and no significant pathology (indicating healing and recovery) in the survivors.[64]. A current acute oral toxicity study using two doses indicated the LD50 for PPOA was between 500 and 2000 mg/kg and reported similar clinical observations and necropsy findings[12].

No additional oral toxicity testing is proposed because doses sufficient to cause toxicity appears to be indirectly toxic by causing gastrointestinal bleeding and distress. It is expected that even dilute solutions would cause gastrointestinal irritation and consequent animal distress. The gastrointestinal irritation and consequent animal distress would be expected to be exacerbated by repeated dosing.

7.3.2. Dermal

No mortality was observed in a single dose study with 24 hour exposure to neat BPA at 4640 mg/kg in rabbits[11]. In this study, moderate erythema was observed which subsided within four days.

No mortality was observed in a single dose study of with 24 hour exposure to neat PPOA at a dose 2000 mg/kg in rats[65].

At least slight dermal irritation was noted in all animals. Slight to moderate erythema was noted in all animals on Study Days 1 and 3 with the exception of one female which had a score of 3 and necrotic appearing areas on Study Day 3. Two on 5 females had erythema scores of 2 and edema scores on 1 on Study Day 7 and erythema scores of 1 on Study Day 10. Slight to moderate desquamation was noted at the administration site for 9 of 10 animals on Study Day 3 (males and females combined).

The dermal irritation observed in these studies with a single application would be expected to increase in a study with repeated dosing and cause severe animal distress.

7.4. Irritation/Corrosion

When 0.5 gram of neat (without a solvent) BPA was applied under occluded conditions to the flanks of rabbits for 24 hours[57], no erythema or edema was observed at the 24 and 72 hour time points. However, when 0.5 g of BPA was applied to abraded skin for 24 hours (and therefore water was present) all six rabbits had erythema scores of 4 (severe)

at the 24 and 72 hour time points. The edema scores was 4 for all six rabbits at the 24 hour time point and lower at the 72 hour time point. The difference in scores between the intact and abraded skin is probably due to the presence of water released from the abrasion and producing, essentially, a saturated solution of BPA in contact with the abraded skin. Based on the observations with PPOA described below where the PPOA was moistened, severe skin lesions were produced. The need for water for BPA to manifest its irritant properties is consistent with the observation that administration of BPA in the eye lead to gross destruction of the cornea and all surrounding tissues[57].

In rabbits, application of neat PPOA under semi-occluded conditions for 4 hours produced severe erythema and slight to moderate edema. Necrotic appearing areas and skin ulcerations were observed at all test sites. The study was terminated prematurely on Study Day 7 because of ulceration of the skin at the test site of all three animals. The primary dermal irritation index was determined to be 6.5 (considered to be severely irritating)[66].

These studies show that BPA and PPOA can be irritating with dermal exposure and because they show acute irritation, repeated dermal dosing would be very likely to cause cumulative dermal injury and animal distress.

7.5. Sensitization

PPOA was not considered to be a skin sensitizer in a recent Magnusson and Kligman maximization test in guinea pigs because none of the animals showed a dermal reaction to the challenge application of the 10% w/w mixture of PPOA in petrolatum.[67]

7.6. Repeated Dose Toxicity

Rats fed diet containing 0.0, 0.1 or 1% corresponding to approximately 0, 85, and 863 mg/kg of BPA in corn oil in the diet for 14 days did not show toxic signs. Weight gain, feed intake, and clinical signs were normal in both dosed groups. Clinical chemistry (aspartate aminotransferease, alanine aminotransferase, lactic dehydrogenase, alkaline phosphatase, urea nitrogen, glucose and creatinine), hematology (red and white blood cell counts, red cell indices, platelet count hemoglobin concentration, and hematocrit) and relative and absolute liver kidney weights were normal in both dosed groups. No compound-related lesions were found in the gross and histopathologic examinations. No site of toxic action was identified in this repeated dose study[68]. This result is consistent with the preceding acute gavage studies because rats eat over an extended period of time per day and this study clearly shows that repeated doses which are not concentrated in composition or time and do not cause acute gastrointestinal injury do not show signs of toxicity. In this study 863 mg/kg in the diet for 14 days did not show any signs of toxicity but in the ALD study cited above rats receiving a bolus dose of 450 mg/kg showed evidence of gastritis.

No additional mammalian toxicology testing is recommended because the most relevant study, a combined repeated dose/reproductive study with the OECD 422 design, by the most relevant route (dermal) would be expected to cause severe skin

irritation with repeated dosing and serious animal distress which would interfere with the purpose of the study.

No additional oral toxicity testing is proposed because doses sufficient to cause toxicity appears to be indirectly toxic by causing gastrointestinal bleeding and distress. It is expected that even dilute solutions would cause gastrointestinal irritation and consequent animal distress. The gastrointestinal irritation and consequent animal distress would be expected to be exacerbated by repeated dosing.

7.7. Reproductive/Developmental Toxicity

No information on reproductive/developmental toxicity was located on BPD and BPA and testing is not appropriate given the acute effects of these materials and the apparent lack of significant potential for exposure.

No additional mammalian toxicology testing is recommended because the most relevant study, a combined repeated dose/reproductive study with the OECD 422 design, by the most relevant route (dermal) would be expected to cause severe skin irritation with repeated dosing and serious animal distress which would interfere with the purpose of the study.

No additional oral toxicity testing is proposed because doses sufficient to cause toxicity appear to be indirectly toxic by causing gastrointestinal bleeding and distress. It is expected that even dilute solutions would cause gastrointestinal irritation and consequent animal distress. The gastrointestinal irritation and consequent animal distress would be expected to be exacerbated by repeated dosing.

7.8. Mutagenicity

BPD was tested in a GLP compliant bacterial mutation assay in S. typhimurium and E. Coli[69] In this assay, BPD was mutagenic in S. typhimurium strain TA98 in the presence of S9-mix and in E. coli strain WP2P in both the presence and absence of S9-mix. PPOA was not mutagenic when tested in a GLP compliant bacterial mutation assay in S. typhimurium and E. Coli[58]

As described above, BPD would be expected to rapidly hydrolyze to BPA, PPOA, and phenylphosphine in the aqueous cell culture media, therefore, to meet the needs of the program, BPA is proposed for a bacterial mutation assay in S. typhimurium and E. coli and an in-vitro chromosomal aberrations assay. Because BPD was mutagenic in the bacterial mutation assay and PPOA was not, BPD is proposed for testing an in-vitro chromosomal aberrations assay if there is an important difference in the profile of BPD and BPA in the bacterial mutagenesis assay.

References:

[1] Smock, W. (2003) Survey of BPA/BPD Manufacturers with Responses. BPA/BPD Coalition.
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BPD/BPA Coalition

BPD/BPA Coalition

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201-14874

BPD (Benzene Phosphorous Dichloride) Robust Summaries

Submitted to the U.S. Environmental Protection Agency

by the

BPD/BPA Coalition

November, 2003

20031119075800.

1. Substance Information

CAS Number:	**644-97-3**
Chemical Name:	Phosphonous dichloride, phenyl-
Structural Formula:	$C_6H_5Cl_2P$
Other Names:	**BPD,** Benzene phosphorus dichloride
Exposure Limits:	Not established

2. Physical – Chemical Properties

2.1. Melting Point:

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	No data available
GLP:	No data available
Year:	No data available
Value:	-51 °C
Decomposition:	No data available
Conclusions:	A handbook value for the melting point of BPD is -51 °C
Reliability:	1
Reference:	CRC Handbook of Chemistry and Physics, 75th edition (1944) CRC Press, Boca Raton.
Remarks:	Handbook value
Additional References for Melting Point Studies:	None

2.2. Boiling Point:

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	No data available
GLP:	No data available
Year:	No data available
Value:	225 °C
Pressure:	No data available
Pressure Unit:	No data available
Decomposition:	Not described
Conclusions:	The boiling point of BPD is 225 °C
Reliability:	4

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Reference:	Avecia, Inc. (1998) BPD Refined (Benzene Phosphorus Dichloride) MSDS, revision D, issued 9/24/98
Remarks:	None
Additional References for Boiling Point Studies:	None

2.3. Density:

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	No data available
GLP:	No data available
Year:	No data available
Value:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Density Studies:	None

2.4. Vapor Pressure:

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	No data available
GLP:	No data available
Year:	No data available
Value:	10
Temperature° C:	98
Pressure Unit:	mmHg
Decomposition:	No data available
Conclusions:	The vapor pressure of BPD is 10 at 98 °C
Reliability:	4
Reference:	Avecia, Inc. (1998) BPD Refined (Benzene Phosphorus Dichloride) MSDS, revision D, issued 9/24/98
Remarks:	None
Additional Reference for Vapor Pressure Studies:	None

2.5. Partition Coefficient (log Kow):

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	Not applicable
GLP:	Not applicable

Year:	Not applicable
Log Kow:	Decomposes
Temperature°C:	Not applicable
Conclusions:	Not applicable
Reliability:	Not applicable
Reference:	Not applicable
Remarks:	Rapidly hydrolyzes
Additional References for Partition Coefficient Studies:	None

2.6. Water Solubility:

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	Not applicable
GLP:	Not applicable
Year:	Not applicable
Value at temperature°C:	Not applicable
Description of solubility:	Decomposes
PH value and concentration at temperature °C:	Not applicable
Pka value at 25°C:	Not applicable
Conclusions:	Rapidly hydrolyzes
Reliability:	Not applicable
Reference:	Not applicable
Remarks:	Decomposes
Additional References for Water Solubility Studies:	None

2.7. Flash Point:

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	No data available
GLP:	No data available
Year:	No data available
Results:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None

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Additional References for Flash Point Studies:	None

2.8. Flammability:

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	No data available
GLP:	No data available
Year:	No data available
Results:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Flammability Studies:	None

3. Environmental Fate

3.1. Photodegradation:

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	EPIWIN Model calculation: (AopWin v1.90)
GLP:	Not applicable
Type:	Model calculation
Year:	2003
Light Source:	Not applicable
Light Spectrum (nm):	Not applicable
Half-life:	65.8 hours (5.5 days for 12 hour days)
Breakdown Products:	No data available
Conclusions:	The half-life in the atmosphere for BPA is estimated to be 65.8 hours (5.5 days for 12 hour days)
Reliability	1
Reference:	AOP Version 1.90
Remarks:	None
Additional References for Photodegradation Studies:	None

3.2. Stability in Water:

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	OECD 111
GLP:	Yes
Type:	Laboratory study
Year:	2003
Half-life at a specific pH:	< 1 minute at pH 1.2, 4, 7, and 9 at 25 °C
Breakdown Products:	BPA, phenylphosphonic acid, phenylphosphine, Cl^-
Conclusions:	Rapidly hydrolyzed
Reliability:	1
Reference:	Wildlife International, Ltd. (2003) Hydrolytic stability of benzene phosphonous dichloride. Project number 534C-123.
Remarks:	The industrial process gives a high >95% yield of BPA, but under the OECD 111 conditions, the yield of BPA and PPOA is approximately the same
Additional References for Stability in Water Studies:	None

3.3. Transport (Fugacity):

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	EPIWIN Model calculation (Level III Fugacity Model)
GLP:	No
Type:	Model calculation
Year:	2003
Media:	Air, Water, Soil, Sediment

Distributions:

Compartment	Released 100% to air	Release 100% to water	Release 100% to soil
Air	79.8	0.889	0.0736
Water	12.7	98	0.792
Soil	7.3	0.0813	99.1
Sediment	0.139	1.07	0.00865

Adsorption Coefficient:	No data available
Desorption:	No data available
Volatility:	No data available
Conclusions:	Partitions primarily to soil and water. In the presence of water, BPD will rapidly hydrolyze.
Reliability:	1
Reference:	EPIWIN (version 3.1) STP Fugacity model

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Remarks:	When released equally to air, water, and soil, BPD is estimated to be distributed 7.15 percent to air, 36.7 percent to water, 55.8 percent to soil, and 0.401 percent to sediment
Additional References for Transport (Fugacity) Studies:	None

3.4. Biodegradation:

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	EPIWIN 3.10 (BIOWIN v4.00)
Type:	Model calculation
GLP:	No
Year:	2003
Degradation% after time:	No data available
Breakdown Products:	Hydrolysis products are BPA, PPOA, and phenylphosphine
Concentration Of Test Chemical:	No applicable
Analytical Method:	Not applicable
Conclusions:	Ultimate Biodegradation Timeframe: weeks Primary Biodegradation Timeframe: days-weeks
Reliability:	1
Reference:	BIOWIN v 4.00
Remarks:	BIOWIN fragment descriptor is for an unsubstituted phenyl group
Additional References for Biodegradation Studies:	None

3.5. Bioconcentration:

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	EPIWIN 3.10 (Bcfwin v2.14)
Type:	Model calculation
GLP:	No
Year:	2003
Results:	Log BCF = 1.62 (BCF = 41.72)
Conclusions:	Not expected to bioaccumulate
Reliability:	1
Reference:	Bcfwin Version 2.14
Remarks:	None

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Additional References for Bioconcentration Studies:	None

4. Ecotoxicity

4.1. Acute Toxicity to Fish:

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	EPIWIN 3.10 (ECOSAR Version 0.99)
Type:	Model calculation
GLP:	No
Year:	2003
Species/Strain/:	Not applicable
Supplier:	Not applicable
Analytical Monitoring:	Not applicable
Exposure Period:	96 hours
Nominal/Measured Concentrations:	Not applicable
LC50:	14.908 mg/L at 96 hours
Conclusions:	Predicted to be slightly toxic to fish
Reliability:	1
Reference:	ECOSAR version 0.99
Remarks:	None
Additional References for Acute Toxicity to Fish Studies:	None

4.2. Acute Toxicity to Invertebrates:.

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	EPIWIN 3.10 (ECOSAR version 0.99)
Type:	Model calculation
GLP:	No
Year:	2003
Species/Strain/:	Daphnid
Supplier:	Not applicable
Analytical Monitoring:	Not applicable
Exposure Period:	48 hours
Nominal/Measured Concentrations:	Not applicable
LC50:	17.129 mg/L at 96 hours

Conclusions:	Predicted to be slightly toxic to aquatic organisms
Reliability:	1
Reference:	ECOSAR version 0.99
Remarks:	None
Additional References for Acute Toxicity to Invertebrates Studies:	None

4.3. Acute Toxicity to Aquatic Plants:

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	EPIWIN 3.10 (ECOSAR version 0.99)
Type:	Model calculation
GLP:	No
Year:	2003
Species/Strain/ Supplier:	Green algae
Analytical Monitoring:	Not applicable
Exposure Period:	96 hours
Nominal/Measured Concentrations:	Not applicable
EC50:	11.349 mg/L in green algae at 96 hours
Conclusions:	Predicted to be slightly toxic to green algae
Reliability:	1
Reference:	ECOSAR version 0.99
Remarks:	None
Additional References for Acute Toxicity to Aquatic Plants Studies:	None

5. Mammalian Toxicity

5.1. Acute Toxicity:

5.1.1. Oral

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	OECD 420 Fixed dose
Type:	Guideline
GLP:	Yes
Year:	1997
Species/Strain:	Alpk: Ap_fSD (Wistar-derived)

Sex:	Male and female
No. Of Animals Per Sex Per Dose:	5
Vehicle:	Corn oil
Route Of Administration:	Oral gavage
Time Of Observation Period:	14 days
Doses Administered:	1
LD50:	> 500 mg/kg
Conclusions:	No mortality in the dosed animals at 500 mg/kg. The one rat tested at 2000 mg/kg in the rangefinding test died
Reliability:	1
Reference:	Astra Zeneca Central Toxicology Laboratory (1977) Report number CTL/P/5737. Benzene phosphorous dichloride – refined: Fixed dose acute oral toxicity to the rat
Remarks:	According to the study report, there were no signs of evident toxicity and all animals showed an overall body weight gain during the study. Two male animals had mottled lungs and froth in the trachea at necropsy which may be treatment related. The necropsy data, however, supports the conclusion that the administered BPD was hydrolyzed in vivo, presumably to the relatively strong acids BPA and BPD and that these compounds caused their characteristic effect – gastrointestinal bleeding. The single animal dosed with 2000 mg/kg died on the first day and the necropsy comment was, "stomach and intestine contents dark (black). In addition, all 5 males dosed at 500 mg/kg where noted to have "slight" scores for "activity decreased" on the day of dosing. This is consistent with the interpretation that the hydrolysis products produced gastrointestinal irritation and possible distress. The absence of gastrointestinal findings at necropsy in the 500 mg/kg animals may be attributed to healing.
Additional References for Acute Oral Toxicity Studies:	None

5.1.2. Dermal

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	No data available

Type:	No data available
GLP:	No data available
Year:	No data available
Species/Strain:	No data available
Sex:	No data available
No. Of Animals Per Sex Per Dose:	No data available
Vehicle:	No data available
Route Of Administration:	No data available
Time Of Observation Period:	No data available
Doses Administered:	No data available
LD50:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Acute Dermal Toxicity Studies:	None

5.1.3. Irritation

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	No data available
Type:	No data available
GLP:	No data available
Year:	No data available
Species/Strain:	No data available
Sex:	No data available
No. Of Animals Per Sex Per Dose:	No data available
Vehicle:	No data available
Route Of Administration:	No data available
Time Of Observation Period:	No data available
Concentration Of Test Material:	No data available
Results:	No data available
Conclusions:	No data available

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Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Acute Dermal Irritation Studies:	None

5.1.4. Sensitization

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	No data available
Type:	No data available
GLP:	No data available
Year:	No data available
Species/Strain:	No data available
Sex:	No data available
No. Of Animals Per Sex Per Dose:	No data available
Vehicle:	No data available
Route Of Administration:	No data available
Time Of Observation Period:	No data available
Concentration Of Test Material:	No data available
Results:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Acute Dermal Sensitization Studies:	None

5.1.5. Eye Irritation

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	No data available
Type:	No data available
GLP:	No data available
Year:	No data available
Species/Strain:	No data available
No data available	No data available

Sex:	
No. Of Animals Per Sex Per Dose:	No data available
Vehicle:	No data available
Route Of Administration:	No data available
Time Of Observation Period:	No data available
Concentration Of Test Material:	No data available
Results:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Acute Eye Irritation Studies:	None

5.2. Repeated Dose Toxicity:

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	No data available
Type:	No data available
GLP:	No data available
Year:	No data available
Species/Strain:	No data available
Sex:	No data available
No. Of Animals Per Sex Per Dose:	No data available
Vehicle:	No data available
Route of Administration:	No data available
Time of Observation Period:	No data available
Doses Administered:	No data available
Frequency of Treatment:	No data available
NOAEL (NOEL):	No data available
LOAEL (LOEL):	No data available
Toxic Response By Dose Level:	No data available

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Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Repeated Dose Toxicity Studies:	None

5.3. Reproductive Toxicity:

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	No data available
Type:	No data available
GLP:	No data available
Year:	No data available
Species/Strain:	No data available
Sex:	No data available
No. Of Animals Per Sex Per Dose:	No data available
Vehicle:	No data available
Route Of Administration:	No data available
Time Of Observation Period:	No data available
Doses Administered:	No data available
Frequency Of Treatment:	No data available
Premating Exposure For Males:	No data available
Premating Exposure For Females:	No data available
P NOAEL (NOEL):	No data available
P LOAEL (LOEL):	No data available
F1 NOAEL (NOEL):	No data available
F1 LOAEL (LOEL);	No data available
F2 NOAEL (NOEL):	No data available
F2 LOAEL	No data available

(LOEL):	
P/F1/F2 Toxic Response By Dose Level:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Reproductive Toxicity Studies:	None

5.4. Genetic Toxicity:

5.4.1. *In Vitro* Gene Mutations

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	OECD 471, OECD 472
Type:	Guideline
GLP:	Yes
Year:	1997
Cell Type:	TA1535, TA1537, TA98, TA100, WP2P, WP2P*uvrA*
Metabolic Activation:	S9 was prepared from male Sprague-Dawley rats dosed once dialy by oral gavage with a combined Phenobarbital (80 mg/gk) and β-napthoflavone (100 mg/kg) in corn oil
Concentrations Tested:	50, 100, 200, 500, 1000, 2500 µg/ plate
Vehicle:	DMSO
Cytotoxic Concentration:	2500 µg/ plate (background lawn sparse/absent)
Genotoxic Effects With Metabolic Activation:	Increased revertents with WP2P and TA98
Genotoxic Effects Without Metabolic Activation:	Increased revertents with WP2P
Conclusions:	Mutagenic
Reliability:	1
Reference:	Astra Zeneca Central Toxicology Laboratory (1977) Report number CTL/P/5678. Benzene phosphorous dichloride: Bacterial mutation assay in *S. typhimurium* and *E. coli*
Remarks:	None

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Additional References for In Vitro Gene Mutation Studies:	None

5.4.2. *In Vitro* Chromosome Aberrations

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	No data available
Type:	No data available
GLP:	No data available
Year:	No data available
Cell Type:	No data available
Metabolic Activation Concentrations Tested:	No data available
Vehicle:	No data available
Cytotoxic Concentration:	No data available
Genotoxic Effects With Metabolic Activation:	No data available
Genotoxic Effects Without Metabolic Activation:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for *In Vitro* Chromosome Aberration Studies:	None

5.4.3. *In Vivo* Chromosome Aberrations

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	No data available
Type:	No data available
GLP:	No data available
Year:	No data available
Species/Strain:	No data available
Sex:	No data available
Route Of Administration:	No data available
Vehicle:	No data available

Doses Administered:	No data available
Genotoxic Effects:	No data available
NOAEL (NOEL):	No data available
LOAEL (LOEL):	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for *In Vivo* Chromosome Aberration Studies:	None

5.5. Developmental Toxicity:

Identity:	BPD (phosphonous dichloride, phenyl-) CAS#: 644-97-3
Method:	No data available
Type:	No data available
GLP:	No data available
Year:	No data available
Species/Strain:	No data available
Sex:	No data available
No. Of Animals Per Sex Per Dose:	No data available
Vehicle:	No data available
Route Of Administration:	No data available
Time Of Observation Period:	No data available
Doses Administered:	No data available
Frequency Of Treatment:	No data available
Maternal NOAEL (NOEL):	No data available
Maternal LOAEL (LOEL):	No data available
Fetal NOAEL (NOEL):	No data available
Fetal LOAEL (LOEL):	No data available
Maternal Toxic Response By Dose Level:	No data available

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Fetal Toxic Response By Dose Level:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Developmental Toxicity Studies:	None

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BPD/BPA Coalition

BPD/BPA Coalition

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201-14874

BPA (Benzene Phosphinic Acid) Robust Summaries

Submitted to the U.S. Environmental Protection Agency

by the

BPD/BPA Coalition

November, 2003

20031119080400.

1. Substance Information

CAS Number:	1779-48-2
Chemical Name:	Phosphinic acid, phenyl
Structural Formula:	$C_6H_7O_2P$
Other Names:	BPA, benzene phosphinic acid
Exposure Limits:	Not established

2. Physical – Chemical Properties

2.1. Melting Point:

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	No data available
GLP:	No data available
Year:	No data available
Value:	83 °C
Decomposition:	No data available
Conclusions:	The melting point of BPA is 83 °C
Reliability:	4
Reference:	Akzo Nobel Functional Chemicals LLC (2000) BPA MSDS revision 3, revised 7/12/2000
Remarks:	None
Additional References for Melting Point Studies:	None

2.2. Boiling Point:

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	No data available
GLP:	No data available
Year:	No data available
Value:	180 °C
Pressure:	760
Pressure Unit:	mmHg
Decomposition:	No data available
Conclusions:	The boiling point of BPA is 180 °C
Reliability:	4

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Reference:	Acros Organics MSDS Phenylphosphonic acid. Revision: 2/18/2002
Remarks:	None
Additional References for Boiling Point Studies:	None

2.3. Density:

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	No data available
GLP:	No data available
Year:	No data available
Value:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Density Studies:	None

2.4. Vapor Pressure:

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	Model calculation
GLP:	No
Year:	2003
Value:	0.00014
Temperature° C:	25 °C
Pressure Unit:	mmHg
Decomposition:	No data available
Conclusions:	The vapor pressure of BPA is 0.00014 mmHg
Reliability:	1
Reference:	MBPWIN Version 1.40
Remarks:	None
Additional Reference for Vapor Pressure Studies:	None

2.5. Partition Coefficient (log Kow):

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	Model calculation
GLP:	No
Year:	2003

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Log Kow:	0.04
Temperature°C:	No data available
Conclusions:	The log Kow of BPA is estimated to be 0.04
Reliability:	1
Reference:	WSKOW version 1.40
Remarks:	None
Additional References for Partition Coefficient Studies:	None

2.6. Water Solubility:

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	No data available
GLP:	No
Year:	2003
Value at temperature°C:	77,000 mg/L @25° C
Description of solubility:	No data available
PH value and concentration at temperature °C:	pH = 1 at 25 °C for a saturated solution pH = 2 for a 1% solution
pka value at 25°C:	1.35, 1.92
Conclusions:	The soluability of BPA is 77,000 mg/L @25° C
Reliability:	4
Reference:	Akzo Nobel Functional Chemicals LLC (2000) BPA MSDS revision 3, revised 7/12/2000
Remarks:	pH of saturated solution is 1. Akzo Nobel Chemicals Project 6017000, 6/19/03. pH of a 1% solution is 2. Acros Organics MSDS Phenylphosphonic acid. Revision: 2/18/2002
Additional References for Water Solubility Studies:	PKa reference: Morelli, J.J. (2003) Technical Information Report 31118. Akzo Nobel Chemicals, Inc. Dobbs Ferry, NY.

2.7. Flash Point:

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	No data available
GLP:	No data available
Year:	No data available
Results:	No data available
Conclusions:	No data available
Reliability:	No data available

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Reference:	No data available
Remarks:	None
Additional References for Flash Point Studies:	None

2.8. Flammability:

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	No data available
GLP:	No data available
Year:	No data available
Results:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Flammability Studies:	None

3. Environmental Fate

3.1. Photodegradation:

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	EPIWIN Model calculation: (AopWin v1.90)
GLP:	No
Type:	Model calculation
Year:	2003
Light Source:	Not applicable
Light Spectrum (nm):	Not applicable
Half-life:	61.4 hours (5.1 days for 12 hour days)
Breakdown Products:	No data available
Conclusions:	The half-life of BPA in the atmosphere is 61.4 hours (5.1 days for 12 hour days)
Reliability	1
Reference:	AOP Version 1.90
Remarks:	None
Additional References for Photodegradation Studies:	None

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3.2. Stability in Water:

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	No data available
GLP:	No data available
Type:	No data available
Year:	No data available
Half-life at a specific pH:	No data available
Breakdown Products:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Stability in Water Studies:	None

3.3. Transport (Fugacity):

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	EPIWIN Model calculation STP Fugacity model
GLP:	No
Type:	Model calculation
Year:	2003
Media:	Air, Water, Soil, Sediment

Distributions:

Compartment	Released 100% to air	Release 100% to water	Release 100% to soil
Air	0.118	7.11e-007	0.000175
Water	27.4	99.8	21.6
Soil	72.4	0.000438	78.4
Sediment	0.0461	0.168	0.0363

Adsorption Coefficient:	No data available
Desorption:	No data available
Volatility:	No data available
Conclusions:	Partitions primarily to soil and water
Reliability:	1
Reference:	EPIWIN (version 3.1) STP Fugacity model
Remarks:	When released equally to air, water, and soil, BPA is estimated to be distributed 0.0422 percent to air, 44.9 percent to water, 55 percent to soil, and 0.0755 percent to sediment

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Additional References for Transport (Fugacity) Studies:	None

3.4. Biodegradation:

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	EPIWIN 3.10 (BIOWIN v4.00)
Type:	Model calculation
GLP:	No
Year:	2003
Degradation% after time:	No data available
Breakdown Products:	No data available
Concentration Of Test Chemical:	No data available
Analytical Method:	No applicable
Conclusions:	Ultimate Biodegradation Timeframe: weeks Primary Biodegradation Timeframe: days-weeks
Reliability:	1
Reference:	BIOWIN Version 4.00
Remarks:	None
Additional References for Biodegradation Studies:	None

3.5. Bioconcentration:

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	EPIWIN 3.10 (Bcfwin v2.14)
Type:	Model calculation
GLP:	No
Year:	2003
Results:	Log BCF = 0.5 (BCF = 3.162)
Conclusions:	Not expected to bioaccumulate
Reliability:	1
Reference:	Bcfwin Version 2.14
Remarks:	None
Additional References for Bioconcentration Studies:	None

4. Ecotoxicity

4.1. Acute Toxicity to Fish:

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	EPIWIN 3.10 (ECOSAR Version 0.99)
Type:	Model calculation
GLP:	No
Year:	2003
Species/Strain/:	Not applicable
Supplier:	Not applicable
Analytical Monitoring:	Not applicable
Exposure Period:	96 hours
Nominal/Measured Concentrations:	Not applicable
LC50:	9721.6 mg/L
Conclusions:	Predicted to be practically nontoxic to fish
Reliability:	1
Reference:	ECOSAR Version 0.99
Remarks:	None
Additional References for Acute Toxicity to Fish Studies:	None

4.2. Acute Toxicity to Invertebrates:.

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	EPIWIN 3.10 (ECOSAR version 0.99)
Type:	Model calculation
GLP:	No
Year:	2003
Species/Strain/:	Daphnid
Supplier:	Not applicable
Analytical Monitoring:	No applicable
Exposure Period:	48 hours
Nominal/Measured Concentrations:	Not applicable
LC50:	6857.7 mg/L
Conclusions:	Predicted to be practically nontoxic to invertebrates
Reliability:	1
Reference:	ECOSAR version 0.99
Remarks:	None

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Additional References for Acute Toxicity to Invertebrates Studies:	None

4.3. Acute Toxicity to Aquatic Plants:

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	EPIWIN 3.10 (ECOSAR version 0.99)
Type:	Model calculation
GLP:	No
Year:	2003
Species/Strain/ Supplier:	Green algae
Analytical Monitoring:	Not applicable
Exposure Period:	96 hours
Nominal/Measured Concentrations:	Not applicable
EC50:	3829.8 mg/L
Conclusions:	Predicted to be practically non toxic to green algae
Reliability:	1
Reference:	ECOSAR version 0.99
Remarks:	None
Additional References for Acute Toxicity to Aquatic Plants Studies:	None

5. Mammalian Toxicity

5.1. Acute Toxicity:

5.1.1. Oral

Identity:	BPA (PHOSPHINIC ACID, PHENYL-) CAS# 1779-48-2
Method:	Fixed dose
Type:	Acute oral gavage
GLP:	No
Year:	1969
Species/Strain:	Rat, not specified
Sex:	Male and female
No. Of Animals Per Sex Per Dose:	5
Vehicle:	Water (assumed), 1% tragacanth, 0.5% Tween 20

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Route Of Administration:	Oral (gavage assumed)
Time Of Observation Period:	14 days
Doses Administered:	Females: 464, 1000, 2150 mg/kg as 10% concentration of BPA Males: 1000, 2150, (as 10% concentration of BPA) 4640 mg/kg as 25% concentration of BPA
LD50:	1710 mg/kg for male rats and 1470 mg/kg for female rats
Conclusions:	Females: No apparent toxicity at 464 mg/kg. At necropsy, the 464 mg/kg animals appeared grossly normal. At 1000 mg/kg 5 of 5 animals survided. There was acute depression, dark soft stool, and periods of erratic excitation. At 2150 mg/kg, 5 0f 5 animals died between 6 and 10 hours after dosing. At necropsy, gastrointestinal hemorrhage was noted. Males: The 1000 mg/kg level had no mortality but produced depression subsiding after 48-96 hours. Higher levels produced dark soft stool and acute depression with periods of excitation. At necropsy these animals had areas of necrotic tissue in the gastrointestinal tract. At 2150 mg/kg, 4 of 5 males died between 10 and 14 hours after dosing. At necropsy, the survivor had areas of necrotic tissue in the gastrointestinal tract. At 4640 mg/kg, 5 of 5 males died between 3 and 5 hours after dosing. Necropsy findings describe extensive areas of gastrointestinal hemorrhage.
Reliability:	3
Reference:	Stuaffer Chemical Company (1968) Toxicology Lab Report T-1233 Benzene Phosphinic Acid
Remarks:	The clinical signs described and the necropsy results are consistent with the interpretation that these animals died as a result of the strong acid properties of BPA causing gastrointestinal bleeding and death as a consequence. The clinical signs, in particular, are consistent with the interpretation that these animals probably experienced significant distress.
Additional References for Acute Oral Toxicity Studies:	Haskell Data MR-1703-013, HL-0009-54 cited in Microfiche OTS 05555311 (1992). Eastman Kodak Co, TSCA 8e submission.

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5.1.2. Dermal

Identity:	BPA (PHOSPHINIC ACID, PHENYL-) CAS# 1779-48-2
Method:	Occluded patch
Type:	Acute 24 hour single dose
GLP:	No
Year:	1968
Species/Strain:	Rabbit (not specified)
Sex:	Male and female
No. Of Animals Per Sex Per Dose:	2
Vehicle:	None
Route Of Administration:	Neat material was applied to closely clipped intact abdominal skin under rubber dental damming secured with gauze and tape for 24 hours.
Time Of Observation Period:	14 days
Doses Administered:	4460 mg/kg as neat material, as received
LD50:	> 4460 mg/kg
Conclusions:	Moderate erythema was observed which subsided within 4 days. No eschar was observed.
Reliability:	3
Reference:	Stuaffer Chemical Company (1968) Toxicology Lab Report T-1233 Benzene Phosphinic Acid
Remarks:	None
Additional References for Acute Dermal Toxicity Studies:	None

5.1.3. Irritation

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	Draize (Federal Hazardous Substance Act 21 CFR 191.11)
Type:	Occluded, normal and abraded
GLP:	No
Year:	1968
Species/Strain:	Rabbit (not specified)
Sex:	Male and female
No. Of Animals Per Sex Per Dose:	1 male and 5 females
Vehicle:	None
Route Of Administration:	Neat material was applied to closely clipped intact abdominal skin under rubber dental damming secured with gauze and tape for 24 hours.

Time Of Observation Period:	14 days
Concentration Of Test Material:	500 mg administered neat, as received
Results:	Results: Intact skin: Erythema at 24 hours in all animals (2 had a score of 1, the remaining had a score of 2)and 2 of 6 animals had erythema scores of 1 at 48 hours. No edema was noted in at the intact administration sites. Abraded skin: All rabbits had erythema scores of 4 at 24 and 72 hours. Edema scores at 24 hours ranged from 1-3 with an average of 1.8. At 72 hours, the average erythema score as 3.7.
Conclusions:	Overall, the primary irritation index was 3.9 and considered a moderate skin irritant. Because the primary irritation index was < 5, BPA was not considered to be a primary skin irritant.
Reliability:	3
Reference:	Stuaffer Chemical Company (1968) Toxicology Lab Report T-1233 Benzene Phosphinic Acid
Remarks:	It is probable that these results are at least partially artifactual in that the material was applied as neat material. The material applied to the abraded skin was in contact with aqueous serosanguinious fluid and probably rapidly became a saturated acid solution with a pH of approximately 1. The minimal moisture at the intact sites probably lead to a lack of a significant amount of the saturated solution in contact with the skin. Contemporary practice would include wetting the material with a solvent or water to increase skin contact. If this procedure had been in this study, the response on intact and abraded skin would probably have been similar and the conclusion reached that BPA was a moderate skin irritant.
Additional References for Acute Dermal Irritation Studies:	None

5.1.4. Sensitization

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	No data available
Type:	No data available
GLP:	No data available
Year:	No data available

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Species/Strain:	No data available
Sex:	No data available
No. Of Animals Per Sex Per Dose:	No data available
Vehicle:	No data available
Route Of Administration:	No data available
Time Of Observation Period:	No data available
Concentration Of Test Material:	No data available
Results:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Acute Dermal Sensitization Studies:	None

5.1.5. Eye Irritation

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	Draize
Type:	No
GLP:	No
Year:	1968
Species/Strain:	Rabbit (not specified)
Sex:	Male and female
No. Of Animals Per Sex Per Dose:	3
Vehicle:	None
Route Of Administration:	Conjunctival sac (assumed)
Time Of Observation Period:	72 hours
Concentration Of Test Material:	10 mg of BPA as received, probably > 95%
Results:	Pain, complete destruction of eye structure and most of conjunctivia, severe hemorrhage.
Conclusions:	Severe eye irritant
Reliability:	3

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Reference:	Stuaffer Chemical Company (1968) Toxicology Lab Report T-1233 Benzene Phosphinic Acid
Remarks:	None
Additional References for Acute Eye Irritation Studies:	None

5.2. Repeated Dose Toxicity:

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	No data available
Type:	No data available
GLP:	No data available
Year:	No data available
Species/Strain:	No data available
Sex:	No data available
No. Of Animals Per Sex Per Dose:	No data available
Vehicle:	No data available
Route of Administration:	No data available
Time of Observation Period:	No data available
Doses Administered:	No data available
Frequency of Treatment:	No data available
NOAEL (NOEL):	No data available
LOAEL (LOEL):	No data available
Toxic Response By Dose Level:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Repeated Dose Toxicity Studies:	Haskall Laboratories (1982) Summary of Basic Toxicity 82-0083 Phenylphosphinic acid. Cited in MicrofícheOTS 05555311 (1992) Eastman Kodak Co, TSCA 8e submission

5.3. Reproductive Toxicity:

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	No data available
Type:	No data available

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GLP:	No data available
Year:	No data available
Species/Strain:	No data available
Sex:	No data available
No. Of Animals Per Sex Per Dose:	No data available
Vehicle:	No data available
Route Of Administration:	No data available
Time Of Observation Period:	No data available
Doses Administered:	No data available
Frequency Of Treatment:	No data available
Premating Exposure For Males:	No data available
Premating Exposure For Females:	No data available
P NOAEL (NOEL):	No data available
P LOAEL (LOEL):	No data available
F1 NOAEL (NOEL):	No data available
F1 LOAEL (LOEL);	No data available
F2 NOAEL (NOEL):	No data available
F2 LOAEL (LOEL):	No data available
P/F1/F2 Toxic Response By Dose Level:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Reproductive Toxicity Studies:	None

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5.4. *Genetic Toxicity:*

5.4.1. *In Vitro* Gene Mutations

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	No data available
Type:	No data available
GLP:	No data available
Year:	No data available
Cell Type:	No data available
Metabolic Activation:	No data available
Concentrations Tested:	No data available
Vehicle:	No data available
Cytotoxic Concentration:	No data available
Genotoxic Effects With Metabolic Activation:	No data available
Genotoxic Effects Without Metabolic Activation:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for In Vitro Gene Mutation Studies:	None

5.4.2. *In Vitro* Chromosome Aberrations

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	No data available
Type:	No data available
GLP:	No data available
Year:	No data available
Cell Type:	No data available
Metabolic Activation	No data available
Concentrations Tested:	No data available
Vehicle:	No data available
Cytotoxic Concentration:	No data available

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Genotoxic Effects With Metabolic Activation:	No data available
Genotoxic Effects Without Metabolic Activation:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for *In Vitro* Chromosome Aberration Studies:	None

5.4.3. *In Vivo* Chromosome Aberrations

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	No data available
Type:	No data available
GLP:	No data available
No data available	No data available
Year:	
Species/Strain:	No data available
Sex:	No data available
Route Of Administration:	No data available
Vehicle:	No data available
Doses Administered:	No data available
Genotoxic Effects:	No data available
NOAEL (NOEL):	No data available
LOAEL (LOEL):	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for *In Vivo* Chromosome Aberration Studies:	None

5.5. Developmental Toxicity:

Identity:	BPA (phosphinic acid, phenyl-) CAS# 1779-48-2
Method:	No data available
Type:	No data available

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GLP:	No data available
Year:	No data available
Species/Strain:	No data available
Sex:	V
No. Of Animals Per Sex Per Dose:	No data available
Vehicle:	No data available
Route Of Administration:	No data available
Time Of Observation Period:	No data available
Doses Administered:	No data available
Frequency Of Treatment:	No data available
Maternal NOAEL (NOEL):	No data available
Maternal LOAEL (LOEL):	No data available
Fetal NOAEL (NOEL):	No data available
Fetal LOAEL (LOEL):	No data available
Maternal Toxic Response By Dose Level:	No data available
Fetal Toxic Response By Dose Level:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Developmental Toxicity Studies:	None

20031119080400.

BPD/BPA Coalition

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201-14874

PPOA (Phenylphosphonic Acid) Robust Summaries

Submitted to the U.S. Environmental Protection Agency

by the

BPD/BPA Coalition

November, 2003

20031119080600.

1. Substance Information

CAS Number:	1571-33-1
Chemical Name:	Phosphonic acid, phenyl-
Structural Formula:	$C_6H_7O_3P$
Other Names:	PPOA, phenylphosphonic acid
Exposure Limits:	Not established

2. Physical – Chemical Properties

2.1. *Melting Point:*

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	No data available
GLP:	No
Year:	No data available
Value:	162 °C
Decomposition:	No data available
Conclusions:	The melting point of PPOA is 162 °C
Reliability:	3
Reference:	Sigma-Aldrich (2002) MSDS Phenylphosphonic Acid.
Remarks:	None
Additional References for Melting Point Studies:	None

2.2. *Boiling Point:*

Identity:	PPOA
Method:	No data available
GLP:	No
Year:	No data available
Value:	Decomposes @ 271 °C
Pressure:	No data available
Pressure Unit:	No data available
Decomposition:	Decomposes @ 271 °C
Conclusions:	No boiling point because PPOA decomposes @ 271 °C
Reliability:	3
Reference:	Akzo Nobel Functional Chemicals LLC (2001) MSDS

	Phenylphosphonic Acid
Remarks:	None
Additional References for Boiling Point Studies:	None

2.3. Density:

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	No data available
GLP:	No data available
Year:	No data available
Value:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Density Studies:	None

2.4. Vapor Pressure:

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	No data available
GLP:	No
Year:	No data available
Value:	0.2 mmHg
Temperature° C:	25 °C
Pressure Unit:	mmHg
Decomposition:	No data available
Conclusions:	The vapor pressure of PPOA is 0.2 mmHg
Reliability:	3
Reference:	Akzo Nobel Functional Chemicals LLC (2001) MSDS Phenylphosphonic Acid
Remarks:	None
Additional Reference for Vapor Pressure Studies:	None

2.5. Partition Coefficient (log Kow):

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	Model calculation
GLP:	No
Year:	2003

Log Kow:	0.52
Temperature°C:	No data available
Conclusions:	The log Kow of PPOA is estimated to be 0.52
Reliability:	1
Reference:	WSKOW version 1.40
Remarks:	None
Additional References for Partition Coefficient Studies:	None

2.6. Water Solubility:

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	No data available
GLP:	No
Year:	No data available
Value at temperature°C:	278,000 mg/L
Description of solubility:	No data available
PH value and concentration at temperature °C:	No data available
Pka value at 25°C:	1.85
Conclusions:	The water soluability of PPOA is 278,000 mg/L
Reliability:	3
Reference:	Akzo Nobel Functional Chemicals LLC (2001) MSDS Phenylphosphonic Acid
Remarks:	None
Additional References for Water Solubility Studies:	PKa reference: Morelli, J.J. (2003)

2.7. Flash Point:

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	No data available
GLP:	No data available
Year:	No data available
Results:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None

Additional References for Flash Point Studies:	None

2.8. Flammability:

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	No data available
GLP:	No data available
Year:	No data available
Results:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Flammability Studies:	None

3. Environmental Fate

3.1. Photodegradation:

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	EPIWIN Model calculation: (AopWin v1.90)
GLP:	No
Type:	Model calculation
Year:	2003
Light Source:	No data available
Light Spectrum (nm):	No data available
Half-life:	57.6 hours (4.8 days for 12 hour days)
Breakdown Products:	No data available
Conclusions:	The half-life of PPOA in the atmosphere is 57.6 hours (4.8 days for 12 hour days)
Reliability	1
Reference:	AOP Version 1.90
Remarks:	None
Additional References for Photodegradation Studies:	None

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3.2. Stability in Water:

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	No data available
GLP:	No data available
Type:	No data available
Year:	No data available
Half-life at a specific pH:	No data available
Breakdown Products:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Stability in Water Studies:	None

3.3. Transport (Fugacity):

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	EPIWIN Model calculation STP Fugacity model
GLP:	No
Type:	Model calculation
Year:	2003
Media:	Air, Water, Soil, Sediment

Distributions:

Compartment	Released 100% to air	Release 100% to water	Release 100% to soil
Air	11.3	0.00458	0.267
Water	24.6	99.8	20.5
Soil	64.1	0.026	79.2
Sediment	0.0422	0.171	0.0351

Adsorption Coefficient:	No data available
Desorption:	No data available
Volatility:	No data available
Conclusions:	Partitions primarily to soil and water
Reliability:	1
Reference:	EPIWIN (version 3.1) STP Fugacity model
Remarks:	When released equally to air, water, and soil, BPA is estimated to be distributed 2.92 percent to air, 46.9 percent to water, 50.1 percent to soil, and 0.0805 percent to sediment

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Additional References for Transport (Fugacity) Studies:	None

3.4. Biodegradation:

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	EPIWIN 3.10 (BIOWIN v4.00)
Type:	Model calculation
GLP:	No
Year:	2003
Degradation% after time:	No data available
Breakdown Products:	No data available
Concentration Of Test Chemical:	No data available
Analytical Method:	No applicable
Conclusions:	Ultimate Biodegradation Timeframe: weeks Primary Biodegradation Timeframe: days-weeks
Reliability:	1
Reference:	BIOWIN Version 4.00
Remarks:	None
Additional References for Biodegradation Studies:	None

3.5. Bioconcentration:

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	EPIWIN 3.10 (Bcfwin v2.14)
Type:	Model calculation
GLP:	No
Year:	2003
Results:	Log BCF = 0.5 (BCF = 3.162)
Conclusions:	Not expected to bioaccumulate
Reliability:	1
Reference:	Bcfwin Version 2.14
Remarks:	None
Additional References for Bioconcentration Studies:	None

4. Ecotoxicity

4.1. Acute Toxicity to Fish:

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	EPIWIN 3.10 (ECOSAR Version 0.99)
Type:	Model calculation
GLP:	No
Year:	2003
Species/Strain/:	Not applicable
Supplier:	Not applicable
Analytical Monitoring:	Not applicable
Exposure Period:	96 hours
Nominal/Measured Concentrations:	Not applicable
LC50:	28848.1 mg/L
Conclusions:	Predicted to be practically nontoxic to fish
Reliability:	1
Reference:	ECOSAR Version 0.99
Remarks:	None
Additional References for Acute Toxicity to Fish Studies:	None

4.2. Acute Toxicity to Invertebrates:.

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	EPIWIN 3.10 (ECOSAR version 0.99)
Type:	Model calculation
GLP:	No
Year:	2003
Species/Strain/:	Daphnid
Supplier:	Not applicable
Analytical Monitoring:	No applicable
Exposure Period:	48 hours
Nominal/Measured Concentrations:	Not applicable
LC50:	27907.3 mg/L
Conclusions:	Predicted to be practically nontoxic to invertebrates
Reliability:	1
Reference:	ECOSAR version 0.99
Remarks:	None

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Additional References for Acute Toxicity to Invertebrates Studies:	None

4.3. Acute Toxicity to Aquatic Plants:

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	EPIWIN 3.10 (ECOSAR version 0.99)
Type:	Model calculation
GLP:	No
Year:	2003
Species/Strain/ Supplier:	Green algae
Analytical Monitoring:	Not applicable
Exposure Period:	96 hours
Nominal/Measured Concentrations:	Not applicable
EC50:	3829.8 mg/L
Conclusions:	Predicted to be practically non toxic to green algae
Reliability:	1
Reference:	ECOSAR version 0.99
Remarks:	None
Additional References for Acute Toxicity to Aquatic Plants Studies:	None

5. Mammalian Toxicity

5.1. Acute Toxicity:

5.1.1. Oral

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	OPPTS 870.110
Type:	Guideline
GLP:	Yes
Year:	2000
Species/Strain:	Rat / Crl:CD(SD)IGS BR
Sex:	Male and female
No. Of Animals Per Sex Per Dose:	10
Vehicle:	Distilled water

Route Of Administration:	Oral gavage
Time Of Observation Period:	14 days
Doses Administered:	500 or 2000 mg/kg (dose volume: 5 mL/kg)
LD50:	Between 500 and 2000 mg/kg
Conclusions:	At 500 mg/kg, the clinical sign of staggered gait was seen in 4 of 10 males and 3 of 10 females on the day of dosing. These signs resolved and the animals appeared normal throughout the study and gained body weight. At 2000 mg/kg 3 of 10 males and 4 of 10 females died within 2 days of dosing. Clinical signs included hypoactivity, staggered gait, flaccidity, tremors, liquid feces, and thin appearance. Necropsy observations included multiple dark brown indistinct areas or multiple black eroded areas in the glandular mucosa of the stomach. In two animals the glandular mucosa was thickened and the omentum was dark red and gelatinous.
Reliability:	1
Reference:	Akzo Nobel Chemicals, Inc. (2000) Covance Study 00502647 Acute Oral Toxicity of Phenyl Phosphonic Acid (PPOA) in Rats
Remarks:	The clinical signs and necropsy findings are consistent with the interpretation of effects of ingestion of a strong acid and acute injury to the gastrointestinal tract.
Additional References for Acute Oral Toxicity Studies:	Stuaffer Chemical Company (1972) Toxicology Lab Report T-1918 Benzene Phosphonic Acid

5.1.2. Dermal

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	EPA/OECD Guidelines
Type:	Guideline
GLP:	Yes
Year:	200
Species/Strain:	Rat / Crl:CD(SD)IGS BR
Sex:	Male and Female
No. Of Animals Per Sex Per Dose:	5
Vehicle:	Distilled water
Route Of	Occlusive patch covering gauze with moistened test article

Administration:	
Time Of Observation Period:	14
Doses Administered:	2000 mg/kg to an area of approximately 20 cm^2
LD50:	> 2000 mg/kg
Conclusions:	No mortality and all animals gained weight throughout the study. Maximum individual animal erythema scores ranged from slight to severe. Maximal individual edema reactions ranged from slight to moderate. Subcutaneous hemorrhaging was observed in 2 animals, necrotic appearing areas in another, and fissuring in another. The observed irritation cleared in all 10 animals by the Day 14 observation.
Reliability:	1
Reference:	Akzo Nobel Chemicals Inc. (2000) Covance Study Number 00502648. Acute Dermal Toxicity Study of Phenyl Phosphonic Aid (PPOA) in Rats
Remarks:	None
Additional References for Acute Dermal Toxicity Studies:	Stuaffer Chemical Company (1972) Toxicology Lab Report T-1918 Benzene Phosphonic Acid

5.1.3. Irritation

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	OPPTS 870.2500
Type:	Guideline
GLP:	Yes
Year:	2000
Species/Strain:	Rabbits / Hra(NZW)SPF
Sex:	Male and female
No. Of Animals Per Sex Per Dose:	Two male and one female
Vehicle:	Distilled water
Route Of Administration:	Semioccclusive patch for 4 hours
Time Of Observation Period:	7 days
Concentration Of Test Material:	500 mg, neat, as received
Results:	Severe erythema dnd slight to moderate edema reactions were observed. Necrotic appearing areas and skin

	ulcerations were observed at all three test sites. Ulceration of the skin at the test site of all three animals prompted termination of the study on Day 7. The primary dermal irritation index was 6.5 corresponding to a classification of "severely irritating"
Conclusions:	The material was considered to be severely irritating to rabbit skin
Reliability:	1
Reference:	Akzo Nobel Chemicals Inc. (2000) Covance Study Number 00502649. Primary Dermal Irritation/Corrosion Study of Phenyl Phosphonic Acid (PPOA) in Rabbits
Remarks:	None
Additional References for Acute Dermal Irritation Studies:	None

5.1.4. Sensitization

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	OPPTS 870.2600
Type:	Guideline
GLP:	Yes
Year:	2000
Species/Strain:	Guinea pig / Crl(HA) BR
Sex:	Male
No. Of Animals Per Sex Per Dose:	20 in the Test Group and 10 in the Irritation Control Group
Vehicle:	Mineral oil (for the test material for the intradermal injection on Day 1) Petrolatum (for the test material in the topical induction phase and the challenge phase)
Route Of Administration:	Intradermal and topical
Time Of Observation Period:	24 days
Concentration Of Test Material:	Intradermal 1% w/v in mineral oil Topical induction: 50% w/w in petrolatum Challenge: 10% w/w in petrolatum
Results:	None of the animals in the test or irritation control groups exhibited a dermal reaction to the challenge applications of the test or control materials.
Conclusions:	Because no animals were considered to have exhibited sensitizations reactions, the criterion in the EU guideline of

	30% was not met, and PPOA is not considered a sensitizer.
Reliability:	4
Reference:	Akzo Nobel Chemicals Inc. (2000) Covance Sturdy Number 00502651. Dermal Sensitization on Phenyl Phosphonic Acid (PPOA) In Guinea Pigs –Maximization Test
Remarks:	Because PPOA moistened with water is severely irritating, the lack of irritation in the irritation screening study calls into questions the extent of PPOA exposure when applied in petrolateum.
Additional References for Acute Dermal Sensitization Studies:	None

5.1.5. Eye Irritation

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	CFR 191.12
Type:	Guideline
GLP:	No
Year:	1972
Species/Strain:	New Zealand rabbits
Sex:	No data available
No. Of Animals Per Sex Per Dose:	No data available
Vehicle:	None
Route Of Administration:	Conjunctival sac
Time Of Observation Period:	24, 48, and 72 hours
Concentration Of Test Material:	10 mg of neat PPOA
Results:	All test rabbits exhibited gross destruction of the cornea and all surrounding tissues
Conclusions:	Corrosive
Reliability:	2
Reference:	Stauffer Chemical Company (1972) Toxicology Lab Report T-1918. Benzene Phosphonic Acid
Remarks:	None
Additional References for Acute Eye Irritation Studies:	None

5.2. Repeated Dose Toxicity:

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	No data available
Type:	No data available
GLP:	No data available
Year:	No data available
Species/Strain:	No data available
Sex:	No data available
No. Of Animals Per Sex Per Dose:	No data available
Vehicle:	No data available
Route of Administration:	No data available
Time of Observation Period:	No data available
Doses Administered:	No data available
Frequency of Treatment:	No data available
NOAEL (NOEL):	No data available
LOAEL (LOEL):	No data available
Toxic Response By Dose Level:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Repeated Dose Toxicity Studies:	None

5.3. Reproductive Toxicity:

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	No data available
Type:	No data available
GLP:	No data available
Year:	No data available
Species/Strain:	No data available
Sex:	No data available
No. Of Animals Per Sex Per Dose:	No data available
Vehicle:	No data available
Route Of	No data available

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Administration:	
Time Of Observation Period:	No data available
Doses Administered:	No data available
Frequency Of Treatment:	No data available
Premating Exposure For Males:	No data available
Premating Exposure For Females:	No data available
P NOAEL (NOEL):	No data available
P LOAEL (LOEL):	No data available
F1 NOAEL (NOEL):	No data available
F1 LOAEL (LOEL);	No data available
F2 NOAEL (NOEL):	No data available
F2 LOAEL (LOEL):	No data available
P/F1/F2 Toxic Response By Dose Level:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Reproductive Toxicity Studies:	None

5.4. Genetic Toxicity:

5.4.1. *In Vitro* Gene Mutations

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	OECD 409
Type:	Guideline
GLP:	Yes
Year:	2000

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Cell Type:	TA98, TA100, TA1535, TA1537 and WP2*uvr*A
Metabolic Activation:	S9 homogenate prepared from male Sprague-Dawley rats that that been dosed with Aroclor 1254
Concentrations Tested:	33.3, 100, 333, 1000, 3330, and 5000 µg plate
Vehicle:	DMSO
Cytotoxic Concentration:	In the definitive study, there were indications of cytotoxicity for the *e. Coli* strains at 3330 µg plate and all cell types tested at 5000 µg plate.
Genotoxic Effects With Metabolic Activation:	None observed
Genotoxic Effects Without Metabolic Activation:	None observed
Conclusions:	Not genotoxic in the test systems used
Reliability:	2
Reference:	Akzo Nobel Chemicals, Inc. (2000) Covance Study Number 21552-0-409OECD. Salmonella-Escherichia coli/Mammalian-Microsome Reverse Mutation Assay with a Confirmatory Assay with Phenyl Phosphonic Acid (PPOA)
Remarks:	None
Additional References for In Vitro Gene Mutation Studies:	None

5.4.2. *In Vitro* Chromosome Aberrations

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	No data available
Type:	No data available
GLP:	No data available
Year:	No data available
Cell Type:	No data available
Metabolic Activation	No data available
Concentrations Tested:	No data available
Vehicle:	No data available
Cytotoxic Concentration:	No data available
Genotoxic Effects With Metabolic Activation:	No data available
Genotoxic Effects	No data available

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Without Metabolic Activation:	
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for *In Vitro* Chromosome Aberration Studies:	None

5.4.3. *In Vivo* Chromosome Aberrations

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	No data available
Type:	No data available
GLP:	No data available
Year:	No data available
Species/Strain:	No data available
Sex:	No data available
Route Of Administration:	No data available
Vehicle:	No data available
Doses Administered:	No data available
Genotoxic Effects:	No data available
NOAEL (NOEL):	No data available
LOAEL (LOEL):	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for *In Vivo* Chromosome Aberration Studies:	None

5.5. Developmental Toxicity:

Identity:	PPOA (phosphonic acid, phenyl-) CAS# 1571-33-1
Method:	No data available
Type:	No data available
GLP:	No data available
Year:	No data available
Species/Strain:	No data available
Sex:	No data available
No. Of Animals Per	No data available

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Sex Per Dose:	
Vehicle:	No data available
Route Of Administration:	No data available
Time Of Observation Period:	No data available
Doses Administered:	No data available
Frequency Of Treatment:	No data available
Maternal NOAEL (NOEL):	No data available
Maternal LOAEL (LOEL):	No data available
Fetal NOAEL (NOEL):	No data available
Fetal LOAEL (LOEL):	No data available
Maternal Toxic Response By Dose Level:	No data available
Fetal Toxic Response By Dose Level:	No data available
Conclusions:	No data available
Reliability:	No data available
Reference:	No data available
Remarks:	None
Additional References for Developmental Toxicity Studies:	None

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